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A Role for Public Health in the Nuclear Age

Maxwell's article in this issue of the Journal on the hospital response to Three Mile Island,[1] calling for public health officials to participate in the management of potential nuclear catastrophes, is long overdue. While the author is on the right track, he focuses on only one aspect of the problem. In this nuclear age, a radiation health unit is needed in every state health department threatened by such a catastrophe, a unit whose responsibilities and competence extend beyond disaster management.

Of all state agencies, only the health department is uniquely equipped to collect personal radiation health data, to attempt to prevent illness and injury from nuclear reactor accidents, and to coordinate medical management in cases of radiation exposure. The absence of radiation health units in states with nuclear power plants has denied the inherent public health risk from this almost certainly needed source of energy.

Some 25 years ago, Americans enthusiastically welcomed the nation's commitment to nuclear energy. Much of the enthusiasm was spawned by the promise that we had embarked on a new mission—"atoms for peace." The product of that mission would be clean, safe, and cheap energy for all. We believed that promise. Until recently, we assumed that nuclear energy was safe. Although belief in its safety still prevails in many quarters today, that belief was shattered with potentially serious consequences at Three Mile Island on March 28, 1979. Never before was public health so threatened by a man-made accident.

During the first week of the nation's worst nuclear power plant accident, the population around Three Mile Island (TMI) was continuously exposed to very low doses of a variety of radioisotopes, and was continually stressed by the threat of a nuclear catastrophe. No one could be sure that there was a safe standard for this type of human exposure to low level radiation under stressful conditions. No one yet knows whether public health has been or will be significantly affected by the nuclear reactor accident at TMI. We did know, however, that the United Nations' Scientific Committee on the Effects of Atomic Radiation had warned us that the most important effect of low doses of radiation is the occasional induction of malignant diseases.[2] Approximately one month after the accident, the Secretary of the U.S. Department of Health, Education, and Welfare announced there would be between one and ten additional fatal cancers and the same number of additional non-fatal cancers in the 2,000,000 people exposed to radiation within 50 miles of Three Mile Island.[3]

It is known that low levels of radioactive iodine were released into the atmosphere during the TMI accident, and were presumably inhaled or ingested by grazing animals; and it is well documented that low levels of radioiodine were accurately detected in cows' milk following the accident, and presumably ingested by pregnant women.[4] While we know that therapeutic levels of radioactive iodine can eventually produce hypothyroidism in adults, we do not know what effect very low levels of radioiodine might have on embryonic and fetal thyroid glands. Fortuitously, Pennsylvania's Department of Health had begun screening all newborns for thyroid deficiency some nine months prior to the accident; 17 cases of depressed thyroid function were reported statewide in those nine months, eight cases upwind and nine cases downwind of Three Mile Island. During the nine months which followed the accident, 27 cases were reported statewide, seven cases upwind and 20 cases

downwind.[5] Further investigation was indicated immediately to determine whether the increase in neonatal hypothyroidism was real or in any way related to the Three Mile Island accident, as well as to alert parents whose infants may not have been screened for this potentially treatable condition.* Pennsylvania's Department of Health was aware of an abnormal clustering of cases in October 1979 but took no action until February 1980.[7]

The progressive increase in neonatal and infant mortality rates during the six months following start-up irregularities at Three Mile Island's ill-fated Unit 2 may well have been just a coincidence, but these high rates have never been satisfactorily explained. Unit 2 began commercial operation on December 30, 1978. The *New Yorker Magazine* reported that prior to start-up, Unit 2 had been operating with a documented history of maintenance-caused failures in its main feed water system.[8] Although the Nuclear Regulatory Commission had ordered the plant operators not to allow the complete disabling of the emergency feed water system for any purpose during plant operation, plant records show that the system was shutdown for testing on January 3, 1979, February 26, 1979, and on March 26, 1979, two days prior to the accident.

During the first two quarters of 1978, the neonatal mortality rate within a 10-mile radius of Three Mile Island was 8.6 and 7.6 per 1,000 live births respectively. During the first quarter of 1979, following the start up of accident-prone Unit 2, the rate jumped to 17.2; it increased to 19.3 in the quarter following the accident at TMI and returned to 7.8 and 9.3 respectively in the last two quarters of 1979. Statewide, the neonatal mortality rate was 10.8 in 1978 and 9.8 in 1979.[9]

The week-long stress from the threat of an imminent nuclear catastrophe was reflected in data showing increases of 113 per cent in the number of persons using sleeping pills and 88 per cent in those using tranquillizers, while 14 per cent used more alcohol and 32 per cent smoked more cigarettes in the area around Three Mile Island.[10] The side effects from drugs and the known consequences of smoking and alcohol consumption may be just a small fraction of the adverse effects from stress upon the public's health.[11]

The recent discovery of very low levels of radioactive contamination in mouse, rat, and rabbit droppings during the early clean-up process on Three Mile Island is an omen not to be ignored.** If such contamination were to occur in human beings, the health department should be equipped to evaluate both the physical and psychological effects of low level radiation on human health by a long-term continuing investigation. The total lack of physician epidemiologists or, for that matter, any other physicians employed by the US Nuclear Regulatory Commission, Pennsylvania's Bureau of Radiation Protection, or its parent Department of Environmental Resources does not enhance the likelihood that public health effects from radiation exposure will be investigated. In testimony before the President's Commission on TMI, a radiation health physicist from the Commonwealth's Radiation Protection Bureau strongly opposed placing responsibility for radiation health in the Pennsylvania Department of Health.[12]

In order to plan for the protection of the public's health during a radiological emergency, the first question to ask is: what are the immediate and long-term health effects of radiation exposure? Preplanning requires the use of baseline data available to most health departments. These and other public health data should be collected from around each nuclear facility before the installation becomes operational. Data to be collected should include at least measurements of thyroid hormone deficiency in newborns, fetal death rates, neonatal and infant morbidity and mortality rates, known exposure to carcinogens, cancer incidence and prevalence within circumscribed areas around nuclear facilities, occupational history, demographic characteristics, and symptoms of psychological distress of the population at risk, as well as the availability of medical staff support and health care facilities during a radiological emergency.

Communities located near nuclear power plants should have continuous access to public health protection, ideally from physician specialists in radiation medicine. Every health department serving communities at risk of radiation exposure should develop a radiological emergency response plan to handle the health aspects of a nuclear accident. Every such health department should conduct age specific continuing health education programs (especially during puberty and pregnancy) in the vicinity of nuclear power plants, and be prepared to mount preventive, protective, and treatment programs against radiation effects in the event of a nuclear accident. And every such health department should be responsible for coordinating medical staffing patterns and for conducting area-wide medical facility evacuation drills for nuclear reactor accidents or other kinds of radiation catastrophes.

Public health preparedness has been tested in a nuclear reactor accident and has been found wanting. The President's Commission on Three Mile Island asserted in October 1979, "Pennsylvania's Department of Health was not organized to respond to radiological emergencies."[4] If we fail to learn the lessons of Three Mile Island, we shall be unprepared to protect the public's health during the next nuclear reactor accident, wherever it occurs. We cannot ignore the unpredictable catastrophes that may accompany our embrace of nuclear power regardless of our opinion about the wisdom of that embrace; if and when catastrophes occur, we must be prepared to deal with them as expeditiously as possible and, at the same time, to document their impact upon the health of the public.

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*A Select Committee, convened at a later date, was unable to produce clear evidence of an association between radioactive iodine and the incidence of hypothyroidism in Lancaster County, immediately downwind from Three Mile Island; in that County there were six cases of neonatal hypothyroidism, 12 times as many as expected, during the nine months following the accident.[6]

**Telephone Communication with Lake Barrett, Deputy Director of Three Mile Island Program Office, US Nuclear Regulatory Commission, Middletown, PA, November 9, 1981.

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Editor's Report—Peer Review Again

During 1981 the Journal received its usual number of unsolicited manuscripts, 703, more than four out of five of which we would be unable to publish because of space considerations, regardless of their merit.* Most of these submissions passed through the hands of one or more of the 487 reviewers listed on pages 297–298, or the Editorial Board members listed on page 237. The voluntary input of both groups is what makes any professional journal work. The credibility and integrity of such individuals has been challenged in the past, as I pointed out three years ago in these columns.[1] It has been challenged again, at least by inference, in a recent study of the National Science Foundation's (NSF) peer review processing of research grant applications.[2]

The authors of the NSF study are careful to point out that its results cannot be extrapolated to the grant processing of the National Institutes of Health which has also been criticized; the latter involves dialogue and consensus formation on the part of a panel which reviews both the proposal and any critiques of it by outside consultants. In the same way, the NSF study results could be said not to apply to the peer review process of professional journals; the latter is not consensus forcing, but the track record of the investigator is not one of the elements that influence decisions, as is the case with grant reviews.

Nevertheless, the NSF study is bound to cause comment and uneasiness among all those faced with making decisions of a comparable kind, not to speak of those who must, willy-nilly, submit to such decisions. The investigators reached the conclusion that getting a research grant depends to a significant extent on chance; they found reviewer disagreement to be such that, in about half the cases (they report), the values of the reviewers, rather than the merits of the project, determined the outcome.

This conclusion is reminiscent of the finding that referee agreement on papers submitted to professional journals is only slightly better than would be expected by chance.[3] It follows that if a paper is submitted to enough journals it stands a good chance of eventually being published; this corollary is sustained by the experience of others[4] as well as of this Journal.** Nevertheless, this is circumstantial evidence, subject to other interpretations. Before accepting it or the NSF conclusions at their superficial face value, it may be worth taking a closer look.

The NSF study took a series of grant requests that had been peer reviewed, selected another group of peer reviewers from a panel of "experts", and compared the outcome (accept or reject on the basis of numerical score) of the two sets. There is no escaping the fact that the granting agency or editor selects the reviewers, and that value judgments may enter into the selection. In the NSF study, however, the characteristics of the two sets of reviewers were similar, and it was not mathematically possible to demonstrate any systematic bias in reviewer selection so that this explanation was discarded. Procedural differences in the reviewing process seemed also to fail to explain the reversal in verdict that appeared (in one-fourth of the cases) when the scores of the two sets of peer reviewers were rank ordered. The size of the variance of the mean scores (i.e., discrepancies in the scores of individual reviewers reviewing the same grant) of each set of reviewers seemed to offer the best explanation of the reversals.

One problem with both the NSF study analyses and those of referee agreement in journal reviewing is the fact that reviewer recommendations on a check-off sheet must be translated into numerical values in order to be subjected to statistical treatment. Scaling is a common procedure, but interpretation of the terms (poor, fair, good, very good,

*In 1981 we published 83 articles, 56 public health briefs, one supplement, 30 editorials, 16 commentaries, nine "different views", 50 letters to the editor (usually with one or more responses), and four articles in special sections (Public Health Then and Now and Public Health and the Law).

**About 25 per cent of the papers we publish have been previously submitted to another journal. At least half of the papers we reject (tracked via MEDLINE three years after our rejection) have been published later in another journal.